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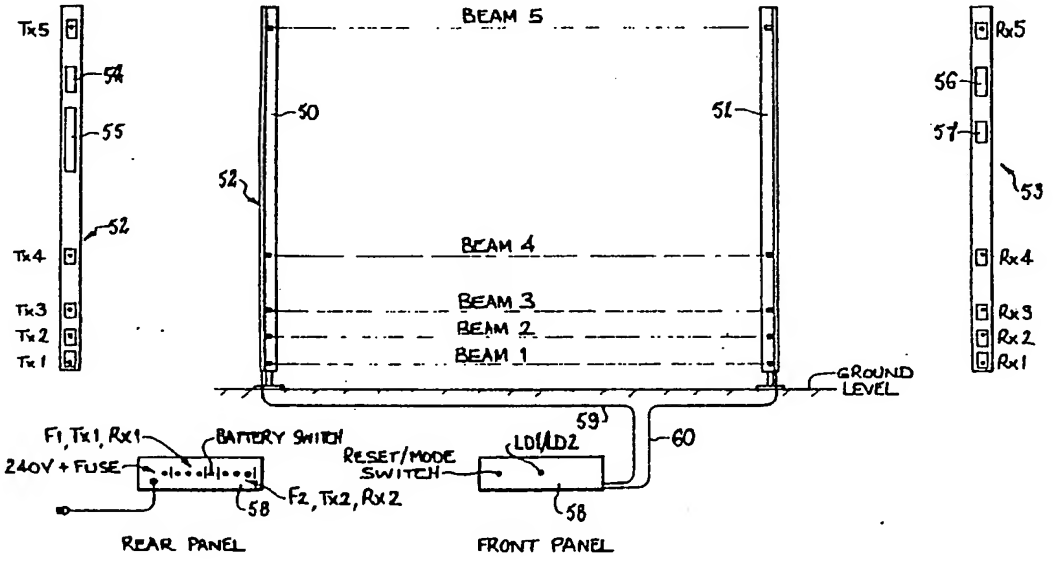
(54) Title: DETECTION SYSTEM



(57) Abstract

A detection system capable of distinguishing between types of intruder passing into a protected area. The detection system includes means (Tx1-5) for transmitting a plurality of electromagnetic (infrared) beams, the beams being arranged such that an intruder passing into the protected area causes a break in at least one of the beams. The detection system includes means (Rx1-5) for receiving the electromagnetic (infrared) beams and for detecting breaks in the beams. The detection system also includes processing means (57) such as a microprocessor for receiving data associated with breaks in the beams. The processing means may initiate an alarm condition whenever the data associated with the breaks in the beams matches a predetermined beam signature i.e. a predetermined number or sequence of breaks in the beams. The microprocessor may be adapted to store a library of beam signatures for the purpose of identifying certain types of intruders. A swimming pool alarm incorporating the above detection system is also disclosed.

DETECTION SYSTEM

The present invention relates to detection systems utilizing electromagnetic radiation. More specifically, this invention relates to a detection system capable of distinguishing between types of intruder passing into a protected area.

Electromagnetic radiation has previously been used for detecting the presence of intruders, whether moving or stationary. Many existing detecting devices incorporate an alarm system which operates on the principle of intercepted electromagnetic radiation. However, a disadvantage of these systems is that they do not distinguish between types of intruder. Such alarm systems trigger regardless of the type of intruder.

The detection system of the present invention may have specific applications, for example detection of persons and other objects passing into a designated area such as a swimming pool.

Detection systems for swimming pools have been available for some time. However, those presently available are designed to detect presence of children or pets after they have fallen into the pool. These systems operate on the principle of inertia detection which relies on a child or pet moving considerably in order for detection to take place. These devices are also subject to wear and corrosion, as by their very nature, they are required to float in the pool for long periods of time.

Pool fence systems are also available, however, these systems are often obtrusive both to the eye and to the space surrounding the pool area. The present invention aims to provide a detection system which alleviates the disadvantages of the prior art.

The detection system of the present invention may include an arrangement of detection posts. The posts may be in communication with processing means. The processing means may include a microprocessor or central processing unit. The processing means may be adapted to identify

arrangement, each transmitting unit may transmit an electromagnetic beam from the secondary post to a corresponding receiving unit of the primary post.

The placement of each receiving unit relative to its corresponding transmitting unit may be such that each receiving unit receives an electromagnetic beam transmitted by a corresponding transmitting unit. The number of beams is not critical, but a number greater than two is preferred.

It is also possible for the secondary post to act as a reflective post, to reflect transmitted beams back to the primary post. In this situation it will be preferable that the primary post contains both transmitting and receiving means.

In one particular preferred embodiment, the system may comprise transmitting units for transmitting five separate electromagnetic beams. The transmitting units may be arranged such that the five beams lie in a substantially vertical arrangement. The arrangement may be such that three transmitting units occupy lower most positions on the post. These lower most units are herein referred to as lower units. The lower units are preferably spaced at approximately equal intervals. Each interval may be between 5 cm to 20 cm. The arrangement may be such that the upper most of the lower units is preferably no more than 60 cm from the ground or surface when the post has been installed. A fourth unit may be located approximately mid way along the post. The fourth unit will herein be referred to as a middle unit. The middle unit may be located between 30 cm and 70 cm from the ground or surface. A fifth unit, may be located in an upper most position on the post. The fifth unit will herein be referred to as an upper unit. The upper unit may be located in the vicinity of the top of the post, and such that it lies preferably between 100 and 250 cm from the ground or surface.

To minimise cross talk between adjacent electromagnetic beams, each beam may be modulated by a modulating system. Each beam may be modulated such that it

to trigger an alarm condition whenever a predetermined beam signature is received.

The processing means may include one or more logic units. The, or each logic unit may be user programmable or it may comprise hard wired logic such as a diode logic array. The processing means of the present invention may include a control unit. The control unit may be integrated with the processing means or it may be remote therefrom.

The receiving units in the primary post preferably are in communication with a logic unit. This logic unit may be contained in the primary post itself. It is preferable that this logic unit is a programmable logic unit and that it is programmed to recognise beam signatures received by the receiving units. An alarm condition preferably exists whenever an intruder intercepts a predetermined number of electromagnetic beams.

In order to provide protection in a specific application, namely a swimming pool detection system, a variety of predetermined beam signature modes may be programmed into the logic unit.

A first mode may be referred to as an active mode. In the active mode, all beams preferably are operating. In one form if any two of the four beams transmitted from the lower units and the middle unit are broken simultaneously, this beam signature may be recognised as an alarm condition. Any breaks in the beams exceeding approximately 40 milliseconds may be registered for evaluation. The system may be programmed so as to disregard breaks under a duration of approximately 40 milliseconds. However, this time duration may be variable depending upon the application of the system.

In another form, if any two of the lower four beams are broken simultaneously for a period of 40 milliseconds, the system may assume alert mode and after 3 seconds may enable the alarm. However if the upper beam is broken during this 3 seconds or at any time, the system may assume a reset condition for 10 seconds and then revert to active mode. In the reset condition, breaks in the lower beams

A fourth mode may be known as a party mode. In the party mode lower beam breaks may be ignored for a period of 3 minutes. After this time the system may revert to active mode. If however the upper beam is broken during this time the system may reset to party mode and restart a three minute timer. Party mode may be initiated from the control unit. The control unit may be adapted to select one or more of the operating modes previously described. In one form the control unit may be adapted to program the processing means to recognise preferred beam signatures.

To minimise risk of false alarms, the width of the beams may be relatively large. The width of the beams preferably are no greater than the width of a child's leg. It is also preferable that the beam width is greater than common objects which may pass through the beam such as the ankle of a cat or a dog. The preferable means for registering a break of the beam is such that the break may only be recognised if the entire width of the beam is blocked or broken. This is preferred as it may enable the beam to distinguish the width of a child's leg which may block a beam entirely, from smaller objects which may pass through the beam without blocking the beam entirely.

Optionally the upper, middle and lower beams may have different widths. For example, the beam from the upper unit may be slightly wider than the beams from the lower units. This may assist distinguishing the upper portion of a human torso which is wider generally than that of a child's leg. It may also assist in distinguishing relatively narrow objects which may pass through the upper beam carried by a child, such as a stick or a broom handle.

It is to be understood that these are only preferred beam signatures which may be recognised, and that other beam signatures may be programmed into the system.

The number of posts is not limited within the scope of the present invention. In another preferred system, four posts may be arranged such that beams of electromagnetic radiation surround the designated area.

unit adapted to receive at least one beam from the first slave post.

The first slave post preferably includes associated logic means. In one form each receiving unit in the first slave post may be in communication with the logic means. The logic means may be adapted to receive break data from the, or each receiving unit of the first slave post. The logic means preferably is adapted to recognise predetermined beam signatures. Output from the logic means may be transmitted to the second post via a modulated beam(s). The latter may be modulated in accordance with the output from the logic means.

The second slave post may also include associated logic means. The latter logic means may be adapted to receive break data from the, or each receiving unit of the second slave post. The logic means of the second slave post may be adapted to recognise break data received from the, or each receiving unit of the second slave post. The output from the logic means of the second slave post may be subsequently transmitted to the primary post via a modulated beam(s). The latter may be modulated in accordance with the output from the logic means of the second slave post.

The primary post may be adapted to recognise predetermined alarm conditions as described for a two post system.

A further preferred embodiment of the invention, may comprise reflective means in each of the posts other than the primary post. The primary post in this situation, may act as both a receiving and transmitting means. The reflective means may comprise mirrors and may be aligned in such a manner that the beam will be reflected around the perimeter of the designated area, returning to the primary post. A break or block to the beam pattern may be detected by the receiving units of the primary post.

Any number of posts may be used to house the reflective means. Means other than posts may be incorporated as means to house the reflective means. The

In figure 1 of the drawings a five beam multiplex system is shown. Each transmitting unit designated Tx1 to Tx5 is incorporated in a secondary post. Each transmitting unit is connected to a multiplex unit MUX as shown. Each transmitting unit has a corresponding receiving unit designated Rx1 to Rx5 incorporated in a primary post. Each receiving unit is connected to a corresponding de-multiplex unit DE-MUX. The de-multiplex unit feeds data from the receiving units to a central processing unit (CPU). The CPU is a preferred processing means. A control unit is incorporated to program the central processing unit, to a selected mode. The CPU is adapted to recognise alarm conditions depending upon the selected mode. An alarm means is triggered by the CPU upon recognition of an alarm condition.

In figure 2 of the drawings, Tx1 to Tx5 designate the transmitting units of a secondary post. Individual modulating units M1 to M5 are associated with corresponding transmitting units Tx1 to Tx5. Corresponding receiving units Rx1 to Rx5 are arranged on a primary post. De-modulating units DM1 to DM5 are associated with corresponding receiving units Rx1 to Rx5. De-modulating units DM1 to DM5 feed data from the receiving units to a central processing unit (CPU). The CPU can be programmed by a control unit to recognise predetermined alarm conditions. An alarm means is triggered by the CPU upon recognition of an alarm condition.

In figure 3 of the drawings, a five beam four post system is shown. This system is a modulated system with transmitting units Tx1 to Tx20 having associated modulating units M1 to M20. Each receiving unit Rx1 to Rx20 has an associated de-modulating unit DM1 to DM20. In this system the secondary post transmits directly to the primary post through transmitting units Tx2, 4, 6, 8 and 10 and to the first slave post through transmitting units Tx1, 3, 5, 7 and 9. Receiving units in both slave posts are connected to respective logic units A and B. In the first slave post, break data received by receiving units Rx1, 3, 5, 7

Microprocessor 57 comprises an 8-Bit EPROM type 68705 with on-board clock, RAM, I/O, and timer. Microprocessor 57 controls all functions of the receiving post 51 and is powered by a 7805, 5 volt regulator as shown at 56b.

Power for the receiving units Rx1 to Rx5 is obtained from the voltage doubler and 16 volt regulator 56a, which is required to allow operation from a 12 volt battery backup.

The five receiving units Rx1 to Rx5 are each divided into two halves, an infrared pre amp 80 and a remote control receiver 81. Remote control receivers of receiving units Rx1 to Rx4 use RS927's, which receive only codes beginning with a "1". The remote control receiver of receiving unit Rx5 uses an RS926 which only receives codes beginning with an "0", ensuring 100% security of the upper beam.

The RS486 of pre amp 80 receives PPM signals via infrared photo-diode IR. The associated circuitry allows the pre amp 80 to present, stable PPM signals to receiver 81 for decoding. The decoded D.C. output is then fed into microprocessor 57.

The system shown in figures 5 to 8 has a number of features which enables continued operation or alarm indication in case of a malfunction. These include:

(a) Alarm mode is assumed if upper beam 5 is not received for a period of 2 minutes;

(b) If any one of the lower beams 1-4 malfunctions the system remains active, however in this situation only one more of the lower beams is required to be broken to initiate an alarm condition. Similarly if two or more of the lower beams fail, alarm mode is assumed.

(c) Any beam break must be greater than 40 milliseconds duration before it is registered as a break. This minimises the chances of false alarms from system gliches or falling leaves or birds etc. passing through the beams.

(d) The alarm times out after a period of time to comply with legislation in some countries.

It will be appreciated that various alterations, modifications and/or additions may be introduced into the constructions and arrangements of parts previously described without departing from the spirit or ambit of the present invention.

The claims defining the invention are as follows:

1. A detection system for detecting an intruder passing into a designated area, said system comprising:

transmitting means for transmitting a plurality of electromagnetic beams, said beams being arranged such that said intruder passing into said area may cause a break in at least one of said beams,

receiving means for receiving said beams and for detecting the or each break in said beams,

processing means for processing data associated with the or each break in said beams and for initiating an alarm condition whenever said data corresponds to a predetermined number or sequence of breaks in said beams.

2. A detection system according to claim 1 wherein said transmitting means comprises a plurality of transmitting units.

3. A detection system according to claim 2 wherein each transmitting unit comprises an infrared diode transmitter.

4. A detection system according to claim 1, 2 or 3 wherein said receiving means comprises a plurality of receiving units.

5. A detection system according to claim 4 wherein each receiving unit comprises an infrared photo-diode.

6. A detection system according to any one of the preceding claims wherein said transmitting means includes means for multiplexing said beams.

7. A detection system according to claim 6 wherein said receiving means includes means for de-multiplexing said beams.

8. A detection system according to any one of the preceding claims wherein said processing means comprises an EPROM microprocessor.

9. A detection system according to any one of the preceding claims wherein said processing means is adapted to evaluate said data associated with the or each break according to a selected operating mode for said system.

10. A detection system according to claim 9 wherein said processing means includes a control unit for selecting said operating mode.

11. A detection system according to claim 10 wherein said control unit is adapted to select active mode, sleep mode, override mode or party mode.

12. A detection system according to any one of the preceding claims including alarm means, said alarm means being actuated by said processing means upon initiation of said alarm condition.

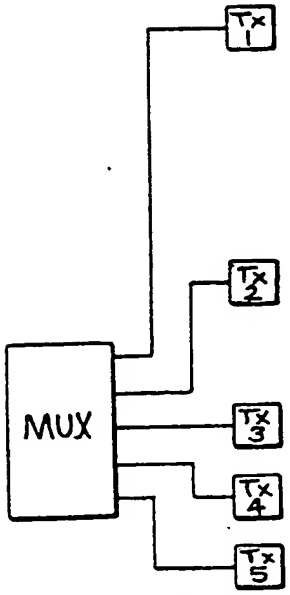
13. A detection system according to any one of the preceding claims wherein said transmitting means is associated with a transmitting post and said receiving means is associated with a receiving post.

14. A detection system according to claim 13 further including at least one slave post.

15. A detection system according to claim 14 wherein said at least one slave post is adapted to relay data to said receiving post.

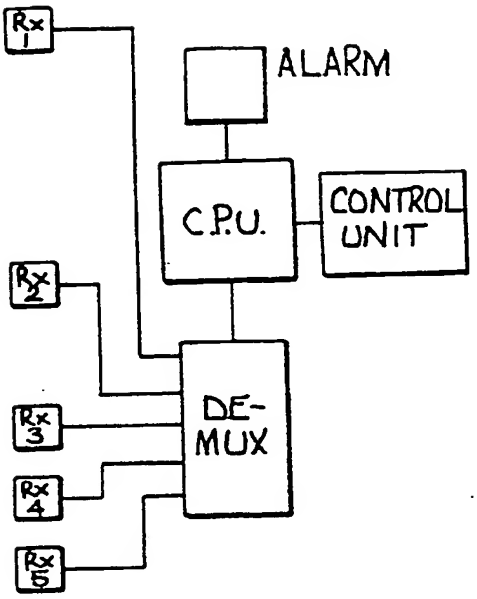
16. A detection system according to claim 1 substantially as herein described with reference to figure 1 or 2 or 3 or 4 or figures 5-8 of the accompanying drawings.

17. A pool alarm incorporating a detection system according to any one of the preceding claims.

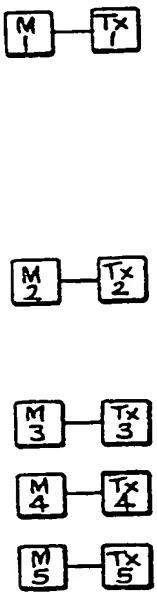


SECONDARY POST

FIG 1

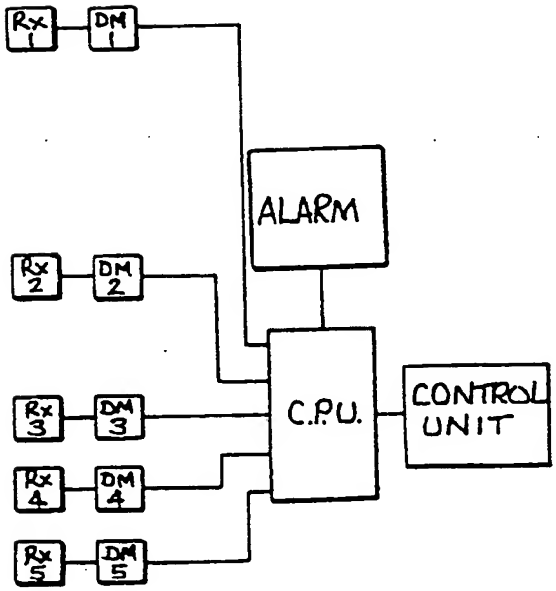


PRIMARY POST

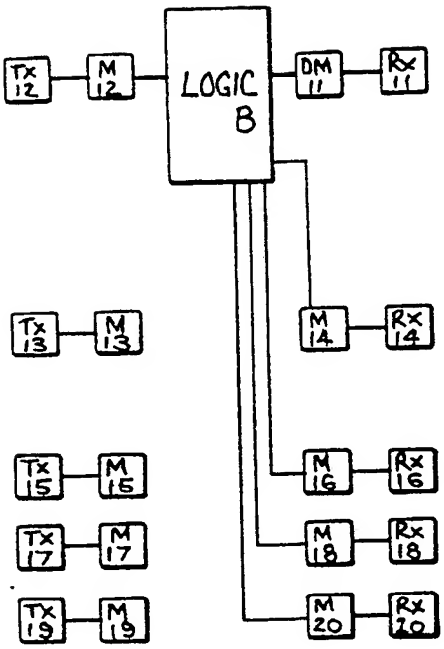


SECONDARY POST

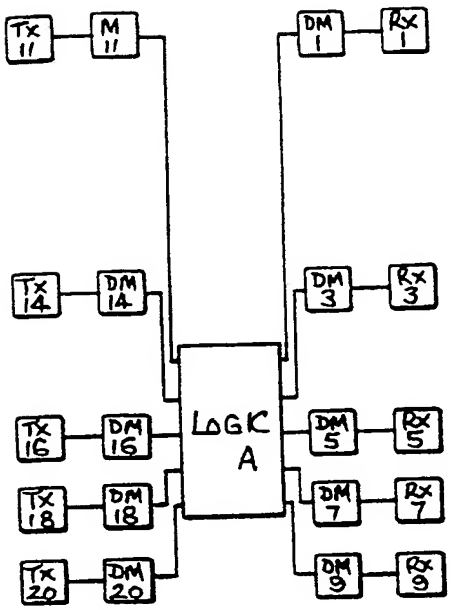
FIG 2



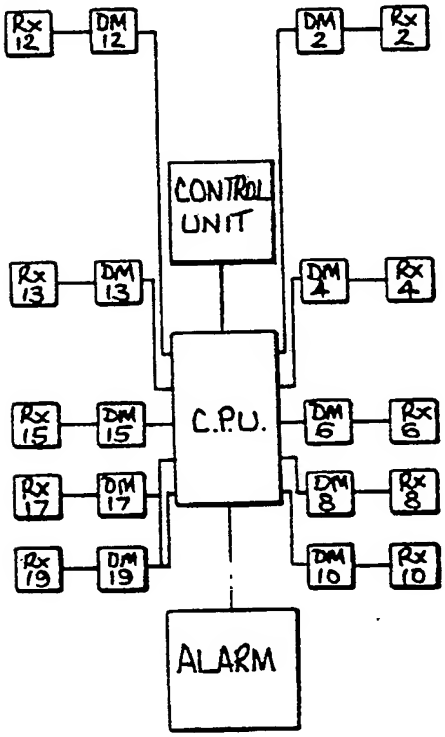
PRIMARY POST



SECOND SLAVE POST



FIRST SLAVE POST



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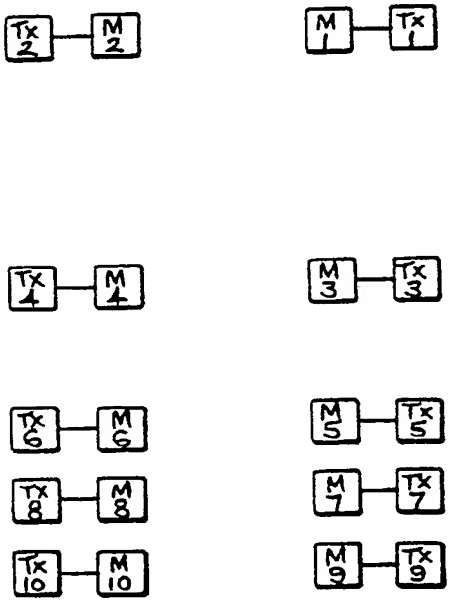

SECONDARY POST

FIG 3

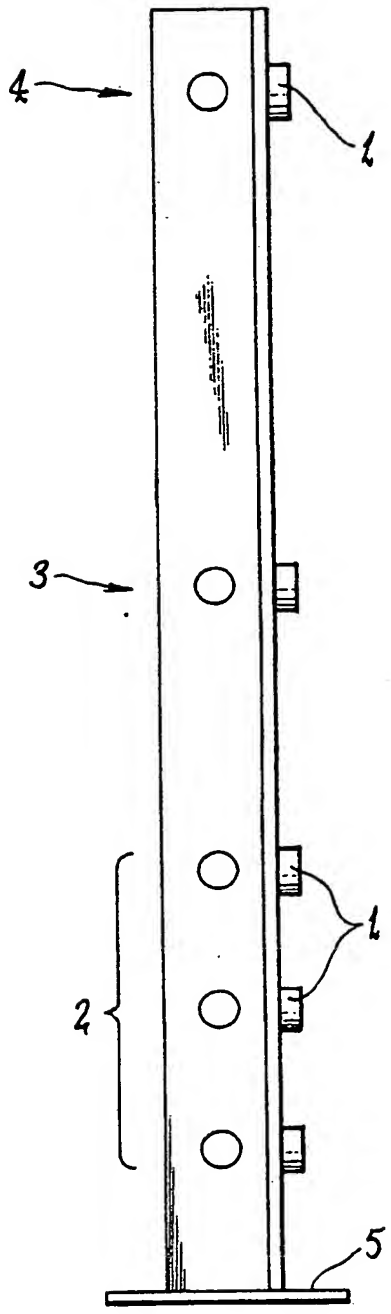

FIG 4

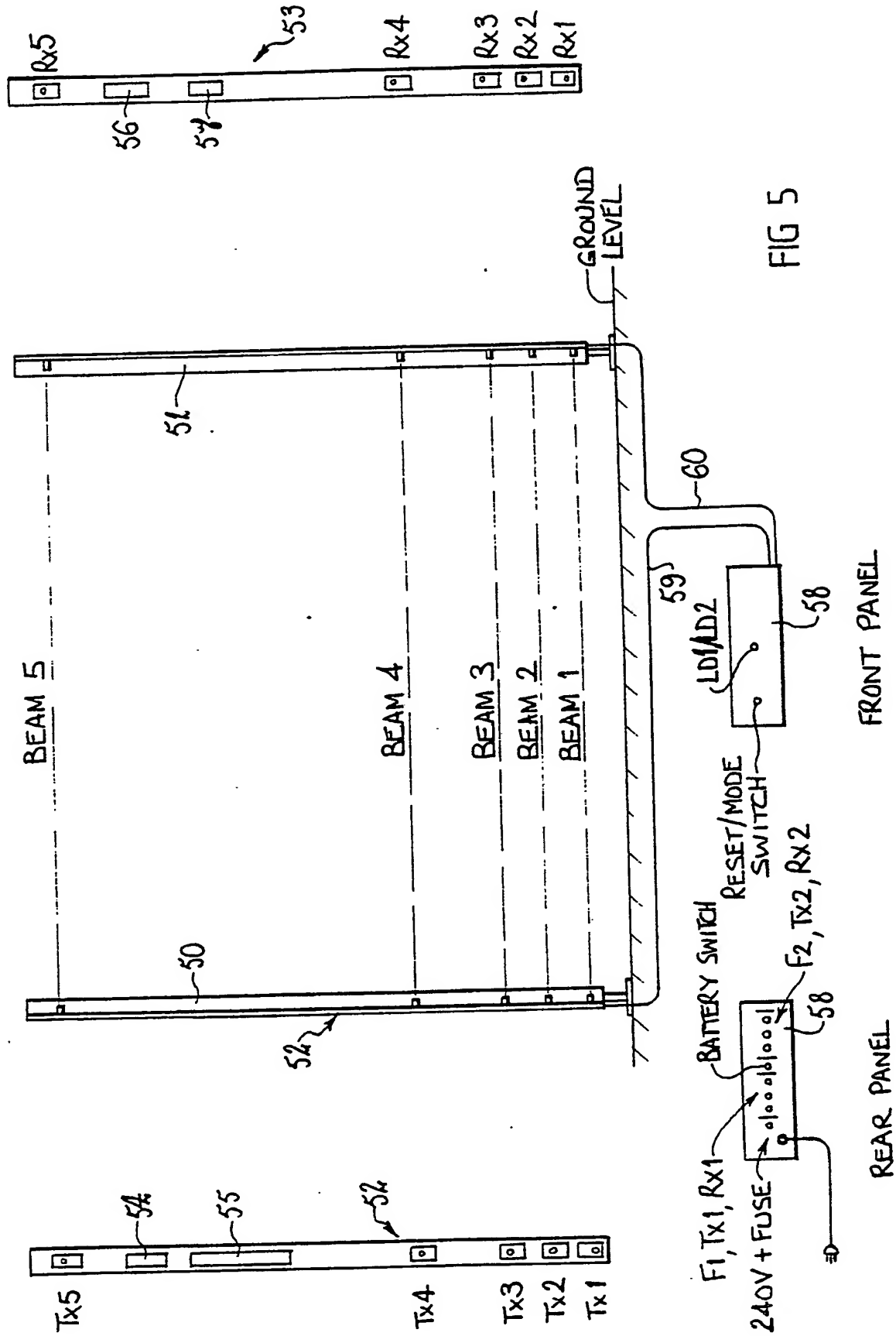
Rx5
53
Rx4
Rx3
Rx2
Rx1
56
54
GROUND LEVEL
51
60
59
58
LD1/LD2
FRONT PANEL
BEAM 5
BEAM 4
BEAM 3
BEAM 2
BEAM 1
RESET/MODE SWITCH
BATTERY SWITCH
F2, Tx2, Rx2
50
52
58
F1, Tx1, Rx1
240V + FUSE
REAR PANEL
54
55
52
Tx5
Tx4
Tx3
Tx2
Tx1

FIG 5

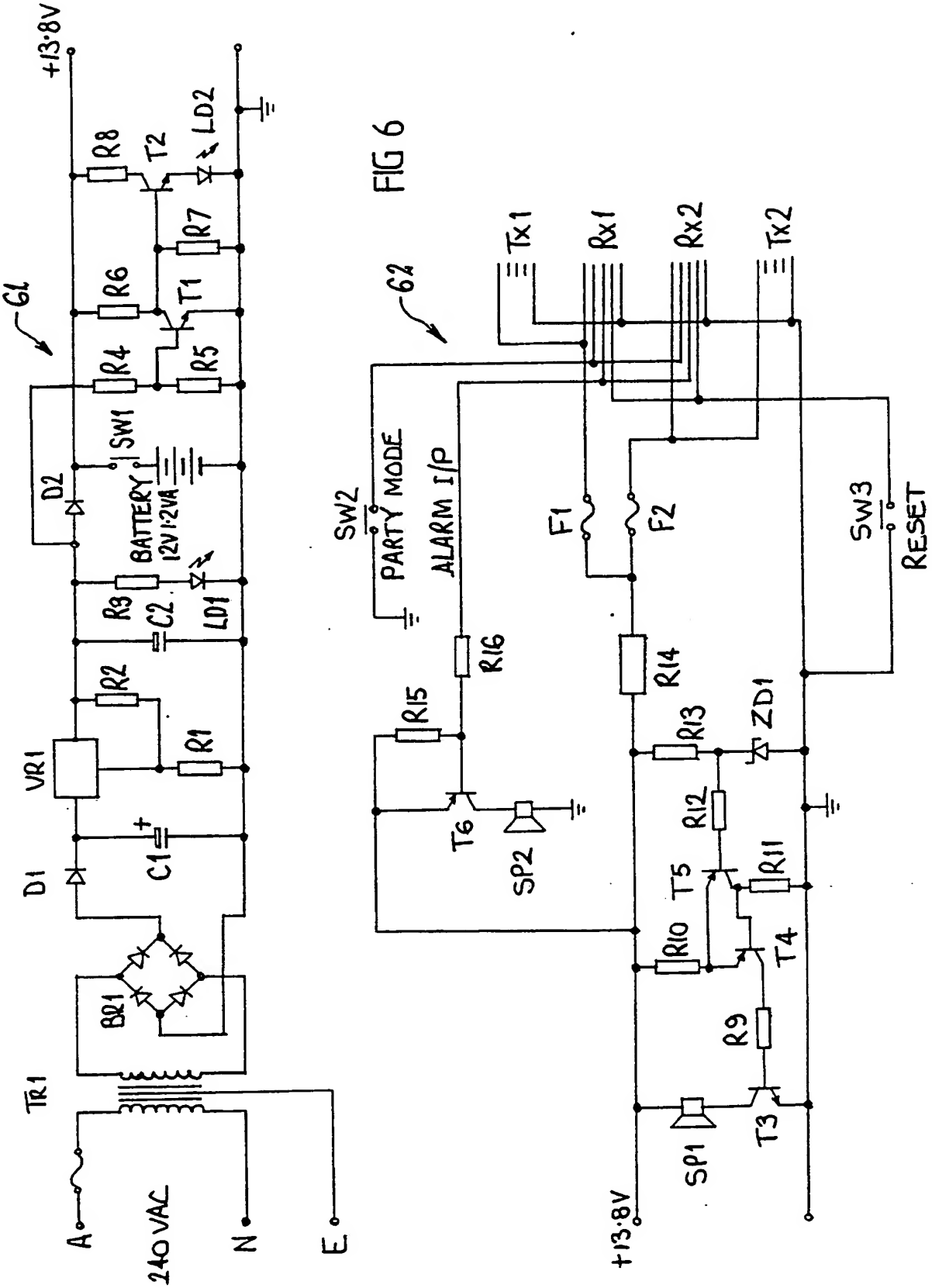
+13·8V
R8
T2
LD2
R7
R6
T1
R4
R5
SW1
D2
BATTERY
12V 1·2VA
R3
C2
LD1
R2
R1
VR1
C1
D1
BR1
TR1
A
240 VAC
N
E
Tx1
Rx1
Rx2
Tx2
SW2
PARTY MODE
ALARM I/P
F1
F2
SW3
RESET
R16
R15
R14
R13
ZD1
T6
SP2
R12
T5
R11
R10
T4
R9
T3
SP1
+13·8V

FIG 6

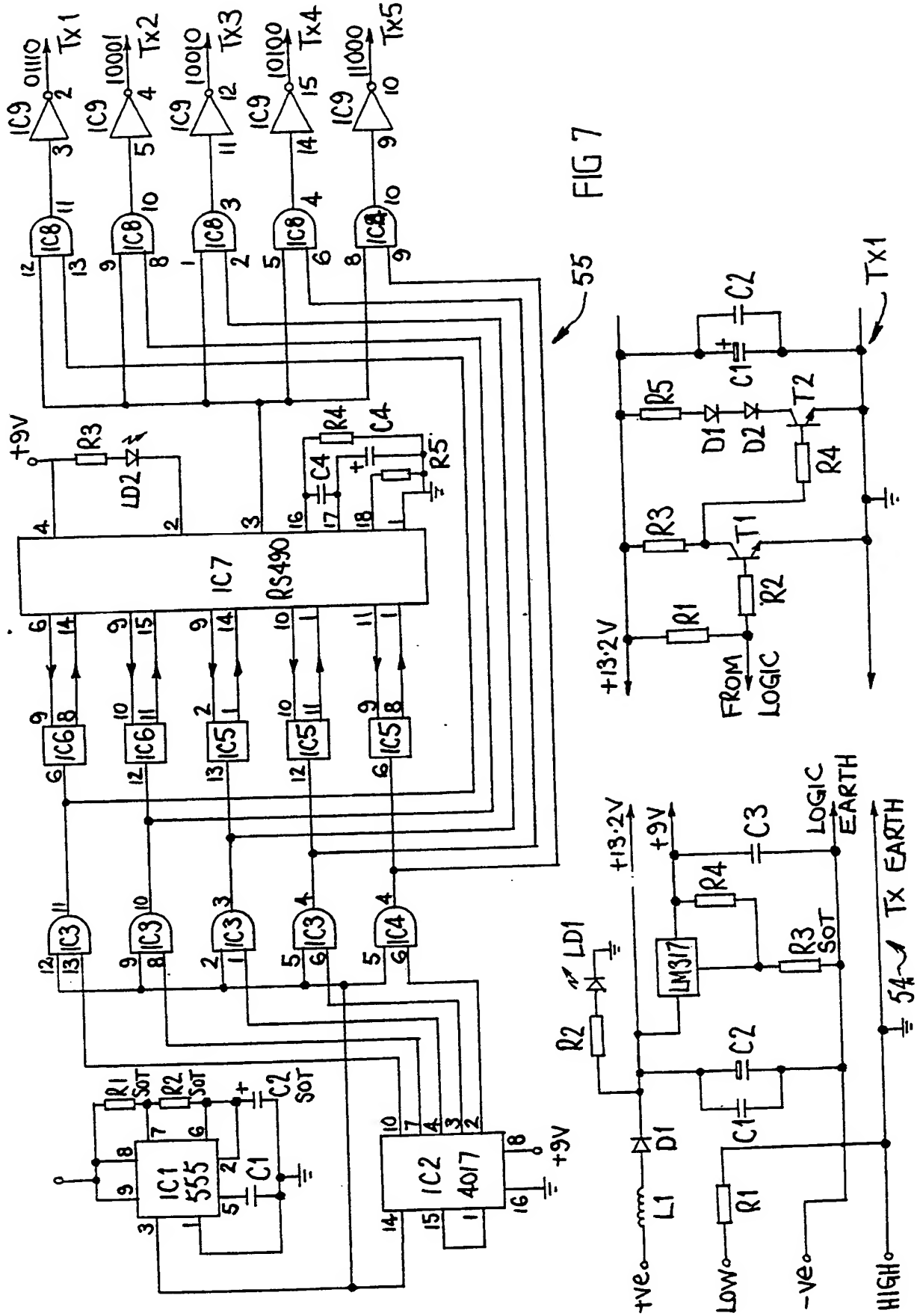

FIG 7

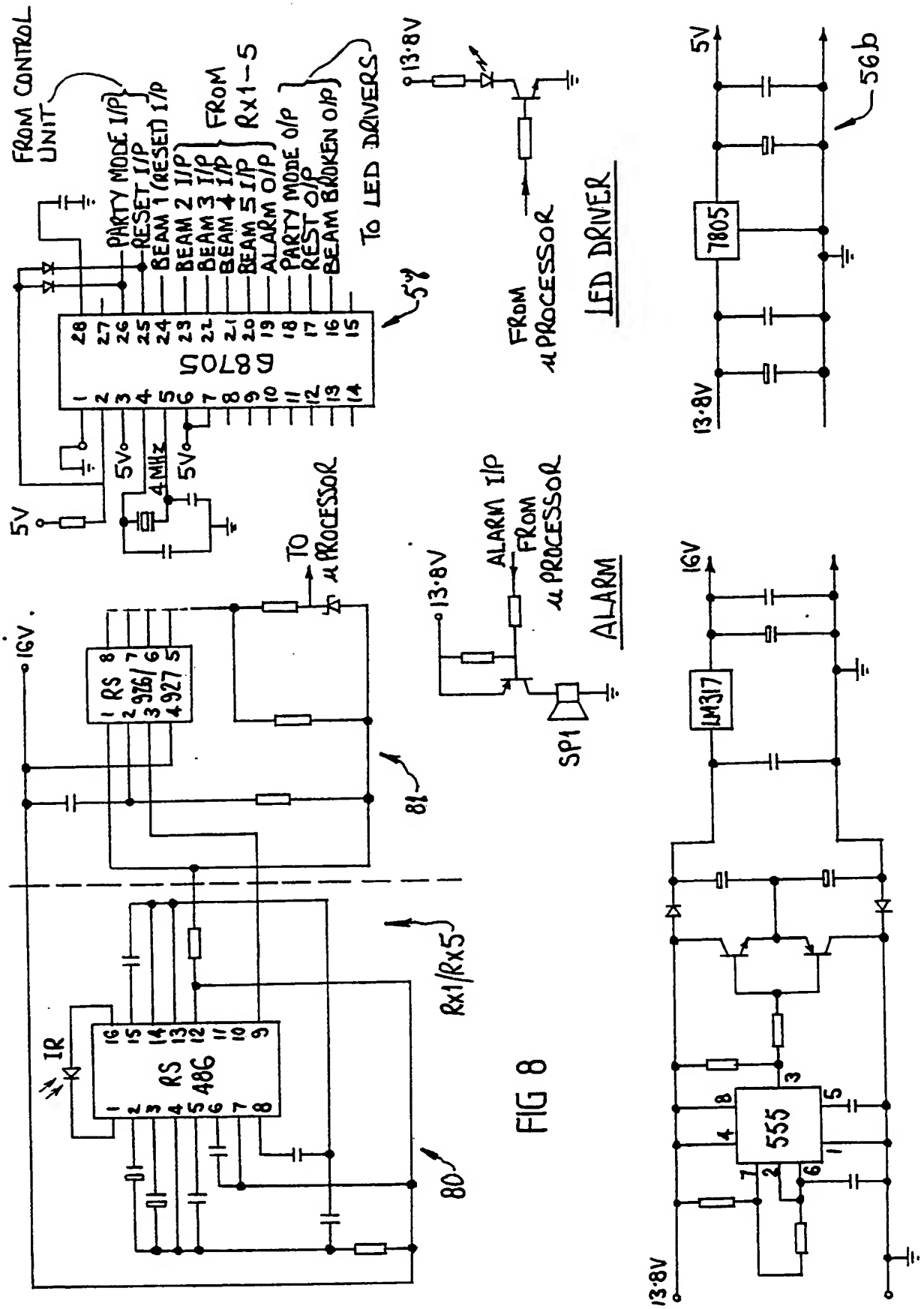
FROM CONTROL UNIT
PARTY MODE I/P
RESET I/P
BEAM 1 (RESET) I/P
BEAM 2 I/P
BEAM 3 I/P
BEAM 4 I/P
BEAM 5 I/P
ALARM O/P
PARTY MODE O/P
REST O/P
BEAM BROKEN O/P
FROM Rx1-5
TO LED DRIVERS
5V
4MHz
5V
5V
TO µPROCESSOR
16V
RS 926/927
81
Rx1/Rx5
IR
RS 486
80
13·8V
FROM µPROCESSOR
LED DRIVER
ALARM I/P
FROM µPROCESSOR
13·8V
ALARM
SP1
5V
7805
56b
13·8V
16V
LM317
555
13·8V

FIG 8

INTERNATIONAL SEARCH REPORT

International Application No PCT/AU 87/00230

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) *

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl.[4] G08B 13/18

II. FIELDS SEARCHED

Minimum Documentation Searched †

Classification System	Classification Symbols
IPC	G08B 13/18

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ‡

AU: IPC as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT §

Category *	Citation of Document, ‖ with indication, where appropriate, of the relevant passages ‡‡	Relevant to Claim No. ††
X,Y	US,A, 3825916 (SEELE et al) 23 July 1974 (23.07.74)	(1-5,8,12-15, 17)
X,Y	AU,A, 90310/82 (HUGHES TECHNOLOGY PTY LTD) 19 May 1983 (19.05.83)	(1,4,8,12-15, 17)
X,Y	WO,A, 84/04986 (HUGHES TECHNOLOGY PTY LTD) 20 December 1984 (20.12.84)	(1,4,8,12,17)
X,Y	GB,A, 1212094 (SHORROCK DEVELOPMENTS LTD) 11 November 1970 (11.11.70)	(1,2,4,8,12, 17)
X,Y	DE,A, 2324008 (HANS) 28 November 1974 (28.11.74)	(1,2,4,8,12, 17)
Y	GB,A, 1524564 (TELUB AB) 13 September 1978 (13.09.78)	(1-5,8,12,13, 17)
Y	CA,A, 1036686 (XENEX CORP) 15 August 1978 (15.08.78)	(1-8,12,13,17)
Y	US,A, 3688298 (MILLER et al) 29 August 1972 (29.08.72)	(1,8,13-15,17)
Y	US,A, 3898639 (MUNCHERYAN) 5 August 1975 (05.08.75)	(1,2,4,8,13-15, 17)

* Special categories of cited documents: ††
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
28 September 1987 (28.09.87)	(09.10.87) 9 OCTOBER 1987
International Searching Authority: Australian Patent Office	Signature of Authorized Officer: R. Hallett R. HALLETT

Form PCT/ISA/210 (second sheet) (January 1985)

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON
INTERNATIONAL APPLICATION NO. PCT/AU 87/00230

Patent Document Cited in Search Report	Patent Family Members
AU 90310/82	GB 2108743
WO 8404986	AU 30189/84
GB 1524564	CH 592929, DE 2541846, NL 7511114, SE 7411856
CA 1036686	DE 2451100, GB 1482567, US 3970846

END OF ANNEX